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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
NASA-15675 (MARCH 2003)  
NASA  
SUPERSEDING NASA-15675  
(MARCH 2001)  
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SECTION 15675

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03/03

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NASA-15675 (MARCH 2003)  
NATIONAL AERONAUTICS NASA  
AND SPACE ADMINISTRATION SUPERSEDING NASA-15675  
(MARCH 2001)  
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SECTION 15675

AIR-COOLED CONDENSERS  
03/03

\*\*\*\*\*  
NOTE: Delete, revise, or add to the text in this  
section to cover project requirements. Notes are  
for designer information and will not appear in the  
final project specification.

This section covers remote air-cooled condensers for  
processes.

Drawings or schedule shall include total heat  
rejection capacity, capacity conditions, coil  
circuits, and control diagrams.

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PART 1 GENERAL

1.1 REFERENCES

\*\*\*\*\*  
NOTE: The following references should not be  
manually edited except to add new references.  
References not used in the text will automatically  
be deleted from this section of the project  
specification.

\*\*\*\*\*

The publications listed below form a part of this section to the extent  
referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 460 (1994) Remote Mechanical - Draft  
Air-Cooled, Refrigerant Condensers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI 23 (1993) Methods of Testing for Rating  
Positive Displacement Refrigerant  
Compressors and Condensing Units

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE-06	(1997) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE-Hdbk SE-SI	(2000) Handbook, HVAC Systems and Equipment (SI Edition)

ASTM INTERNATIONAL (ASTM)

ASTM A 527/A 527M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM A 90/A 90M	(1995; Rev A) Standard Test Method for Weight (Mass) of Coating on Iron or Steel Articles with Zinc or Zinc Alloy

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940/1	(1986) Mechanical Vibration - Balance Quality Requirements of Rigid Rotors - Part 1: Determination of Permissible Residual Unbalance
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NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electric Equipment (1000 Volts Maximum)
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J636	(1992) V-Belts and Pulleys, Standard
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UNDERWRITERS LABORATORIES (UL)

UL 207	(1993; 6th Ed) UL Standard for Safety Refrigerant - Containing Components and Accessories, Nonelectrical
UL 303	(1987; 7th Ed; Rev thru April 14, 1995; Bulletin Jan 9, 1997) UL Standard for

Safety Refrigeration and Air-Conditioning  
Condensing and Compressor Units

1.2 GENERAL REQUIREMENTS

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NOTE: If Section 15003, "General Mechanical Provisions," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

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Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Manufacturer's Standard Color Chart shall indicate the manufacturer's standard color selections and finishes for condensers.

As-Built Drawings shall be submitted for air-cooled condenser units and shall provide current factual information including deviations from, and amendments to, the drawings and concealed and visible changes in the work.

Results of Contractors survey of Existing Conditions shall include features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

Material, Equipment, and Fixture Lists shall be submitted for air-cooled condenser units including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Control Diagrams shall be submitted for air-cooled condenser units showing the physical and functional relationship of equipment. Electrical diagrams shall show size, type, and capacity of the system.

Design Analysis and Calculations shall be submitted for air-cooled condensers indicating the manufacturer's recommended horsepower wattage ratings, rotational speeds, and piston speeds.

Equipment and Performance Data shall be submitted for air-cooled condensers indicating use life, system functional flows, safety features, and other features such as electrical system protective device ratings.

Equipment Foundation Data shall be submitted including equipment weight and operation loads, location and projection of anchor bolts, and horizontal and vertical clearances for installation, operation, and maintenance. Data shall also include dimensions of foundations and relative elevations, and installation requirements such as noise abatement, vibration isolation, and utility services.

1.3 SUBMITTALS

\*\*\*\*\*

**NOTE: Review submittal description (SD) definitions in Section 01330, "Submittal Procedures," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.**

\*\*\*\*\*

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

#### SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted for air-cooled condenser units in accordance with paragraph entitled, "General Requirements," of this section.

Results of Existing Conditions shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

#### SD-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Motors  
Control Panel  
Air-Cooled Condenser  
Refrigerant-Containing Components

The following shall be submitted for air-cooled condenser units showing in accordance with the paragraph entitled, "General Requirements," of this section.

Control Diagrams  
Installation Drawings  
As-Built Drawings

#### SD-03 Product Data

Equipment Foundation Data shall be submitted for the following items in accordance with the paragraph entitled, "General Requirements," of this section.

Air-Cooled Condenser  
Fans and Drives  
Motors  
Vibration Isolation

Equipment and Performance Data shall be submitted for air-cooled condensers in accordance with paragraph entitled, "General Requirements," of this section.

Manufacturer's catalog data shall be submitted for the following items:

- Air-Cooled Condenser
- Motors
- Control Panel
- Refrigerant-Containing Components
- Fans and Drives
- Condensing Pressure Control
- Casing
- Vibration Isolation
- Spare Parts

#### SD-04 Samples

Manufacturer's Standard Color Chart shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

#### SD-05 Design Data

Design Analysis and Calculations shall be submitted for air-cooled condensers in accordance with paragraph entitled, "General Requirements," of this section.

#### SD-07 Certificates

Listing of Product Installation shall be submitted for air-cooled condenser units in accordance with paragraph entitled, "Installation," of this section.

Certificates of compliance shall be submitted for following items showing conformance with the referenced standards contained in this section.

- Motors
- Control Panel
- Air-Cooled Condenser
- Refrigerant-Containing Components
- Fans and Drives
- Condensing Pressure Control
- Casing
- Vibration Isolation

#### SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

## PART 2 PRODUCTS

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NOTE: Fan and motor balance shall conform to ISO Std.1940/1 - (1986) Balance Quality Requirements of Rigid Rotors - Determination of Permissible Residual Unbalance unless otherwise noted. Motor vibration levels shall conform to NEMA Specification MG-1, Motors and Generators, Part 7 unless otherwise noted.  
\*\*\*\*\*

### 2.1 AIR-COOLED CONDENSER PACKAGE

Air-cooled condenser shall be a packaged, self-contained assembly that includes fans, motors, drives, refrigerant condensing coils, controls, intercomponent piping and wiring, totally enclosed weatherproof casing, and frame mounting; the unit shall be ready for terminal field connections with fully automatic operation.

Condenser and spare parts shall conform to the applicable requirements of UL 303, UL 207, ASHRAE 15, ANSI 23, ARI 460.

\*\*\*\*\*  
NOTE: Revise the following paragraphs as required to suit project conditions. A lower ambient temperature suitability will require a more expensive low-ambient control.  
\*\*\*\*\*

Unit shall be suitable for startup and operation in ambient temperatures as low as 45 degrees F 7 degrees C.

### 2.2 FANS AND DRIVES

\*\*\*\*\*  
NOTE: Select the first paragraph for on-the-roof and other applications where noise is not a factor. Select the second paragraph for on-grade locations adjacent to offices, situations requiring ducting, and generally for low-noise-level areas.  
  
Where noise is a factor, drawings should show limiting speeds, outlet velocities, or noise criteria to suit project conditions.  
\*\*\*\*\*

[Fans shall be propeller type, of corrosion-resistant construction, and shall be statically and dynamically balanced to ISO 1940/1-1986, [G6.3] [G2.5] [\_\_\_\_\_]. Fan discharge shall be vertical. Maximum fan-tip speed shall be 10,000 feet per minute 51 meter per second.]

[Fans shall be double-width, double-inlet, centrifugal-scroll type with forward curved or airfoil section bladed wheels. Fans shall be of

corrosion-resistant construction and shall be statically and dynamically balanced to ISO 1940/1-1986, [G6.3] [G2.5] [\_\_\_\_\_]. Fan shaft first-critical speed shall be at 20 percent above fan operating speed.]

\*\*\*\*\*

**NOTE: Select the first paragraph only for propeller fan units smaller than 5 horsepower with ratings less than 3730 watt. If the second paragraph is selected, not less than two belts should be specified for critical operations.**

\*\*\*\*\*

[Fan drive shall be direct.]

[Fan drive shall be V-belt with corrosion-protected shaft and antifriction type bearings. Drive shall conform to ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 41; and shall be rated at not less than 1.5 times the identification plate motor horsepower wattage, SAE J636. Bearings shall be [sealed against moisture and dirt, shall be prelubricated, and shall be suitable for not less than 10,000 operating hours without need for relubrication] [lubricable type with grease supply and relief fittings together with extension tubing for accessibility where necessary][Bearings shall be permanently lubricated sealed bearings]. Bearing cavity shall be completely packed with a grease suitable for the service.]

\*\*\*\*\*

**NOTE: Modify or delete the following two paragraphs as required.**

\*\*\*\*\*

[Fan drive shall be equipped with an adjustable sheave which shall be sized for installation at its midpoint setting and shall provide 20-percent speed adjustment.

Motors shall be mounted on an adjustable base; motors larger than 10 horsepower with ratings larger than 7460 watt shall be mounted on a pivoted motor base.]

Drive shall be weather-protected. Drive and fan discharge and inlet shall be guarded in accordance with the recommendations of the Occupational Safety and Health Act (OSHA). Fan guards shall be hot-dip galvanized after fabrication and shall be suitable for salt-air atmosphere; electrogalvanizing is not acceptable.

## 2.3 MOTORS

Motors shall conform to NEMA MG 1 and be totally enclosed type.

\*\*\*\*\*

**NOTE: Retain the following paragraph for direct drive units.**

\*\*\*\*\*

[Motors shall be resiliently mounted.]

## 2.4 REFRIGERANT-CONTAINING COMPONENTS

\*\*\*\*\*

**NOTE: Modify the following paragraphs as required to suit project. Check subcooling requirements for project.**

\*\*\*\*\*

Condensing coils shall be designed and sized specifically for air-cooled condenser service. Coil construction shall be seamless copper tube, with copper extended surface integral with or mechanically attached to the tube.

Coil frame shall be not less than 12-gage 2.8 millimeter galvanized steel.

[Coils shall be factory tested pneumatically under water at not less than 400 pounds per square inch gage 2758 kilopascal.] A purging vent shall be provided at the highest point of the entering refrigerant header of each coil circuit. Coil subcooling shall be provided when a differential not greater than 20 degrees F 7 degrees C below zero degrees C exists between condensing and ambient temperatures.

Condenser coil and receiver shall have an excess capacity of not less than 20 percent for storage of pumped-down refrigerant.

Condensing coil and remainder of refrigerant circuit shall be cleaned and factory charged with dry nitrogen or refrigerant.

Coil shall be protected from physical damage.

## 2.5 CONDENSING PRESSURE CONTROL

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**NOTE: Retain the following paragraph only for single-phase powered units.**

\*\*\*\*\*

Condensing pressure control shall be accomplished by an electronic solid-state control system that will modulate speed of a motor conforming to requirements specified herein from 0 to 100 percent by fan cycling or by a combination of these methods.

\*\*\*\*\*

**NOTE: Retain one of the following two paragraphs for single- or three-phase powered units.**

\*\*\*\*\*

[Condensing pressure control shall be accomplished by [condenser-coil flooding system] [modulation of dampers located in the discharge airstream].]

[Condensing pressure control shall be accomplished by [fan cycling] [modulation of dampers located in the discharge airstream] [combination of fan cycling and discharge damper modulation].]

Where condenser is being used as a combination receiver, the pump-down

capacity shall be not less than 80 percent of the available refrigerant volume.

## 2.6 CASING

Casing shall be constructed of minimum 18-gage 1.3 millimeter mill-galvanized steel that has been phosphatized, primed, and finished with the manufacturer's standard enamel. [Casing shall be specially treated for use in a coastal environment.]

\*\*\*\*\*  
**NOTE: Specify 2.5 ounces 71 gram of zinc specifications for "heavy-duty" heavier steel.**  
\*\*\*\*\*

Mill galvanized steel shall conform to ASTM A 527/A 527M and shall be coated with not less than 1.25 ounces 380 gram of zinc per square foot meter of two-sided surface when tested in accordance with ASTM A 90/A 90M.

Casing frame shall be constructed of mill galvanized steel or shall be hot-dip galvanized after fabrication to equal or exceed mill galvanizing requirements.

Casing shall include access doors and coil end enclosure. Control panel may be located within or external to casing.

## 2.7 CONTROL PANEL

\*\*\*\*\*  
**NOTE: Modify the following paragraphs for remote location.**  
\*\*\*\*\*

Condenser-mounted control panel and intercomponent piping and wiring shall be provided. Control panels exposed to the weather shall have NEMA 250, Type 3 enclosures and NEMA 250, Type 1 enclosures if protected by casing. Electrical work shall conform to NFPA 70 requirements and shall incorporate UL-listed components.

\*\*\*\*\*  
**NOTE: Modify the following paragraph to suit project requirements.**  
\*\*\*\*\*

Control panel shall be provided with the following factory-mounted controls: 115-volt control power transformer, fan contactors, fan controls for low ambient operation, and compressor interlock.

## 2.8 VIBRATION ISOLATION

Vibration isolation provisions shall conform to requirements specified under Section 15072, "Vibration Isolation for Air Conditioning Equipment."

## PART 3 EXECUTION

### 3.1 INSTALLATION

Listing of Product Installation shall be submitted for air-cooled condenser units showing at least 5 installed units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

Equipment shall be installed in accordance with manufacturer's recommendations.

Installation Drawings shall be submitted for air-cooled condenser units. Drawings shall indicate overall physical features, dimensions, ratings, service requirements, weights of equipment, and details of equipment room layout and arrangement.

### 3.2 OPERATION AND MAINTENANCE

Contractor shall submit [6] [\_\_\_\_\_] copies of the Operation and Maintenance Manuals 30 days prior to testing the air-cooled condenser units. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

-- End of Section --